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Historical weather accounts from Wales: an assessment of their potential for reconstructing climate

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Introduction

Historical documentary records are recognized as valuable in understanding long-term climate variability (Starkel, 2002; Jacobeit *et al.*, 2003; Lamb, 2005; Brazdil *et al.*, 2006a). In the UK, the Central England Temperature Series (1772–) and the Lamb weather catalogue (1861–) provide a detailed climate record for England, but the value of these archives in Wales and Scotland is more limited. Some long-term instrumental series exist, particularly for cities such as Edinburgh (Dawson *et al.*, 2004; Macdonald *et al.*, 2008), but these are few. The distance from the central England area and a lower density of instrumental stations in Scotland and Wales have limited understanding of climate variability in these western and northern areas during the instrumental period (~1750–), preventing any detailed examination of regional differences. This article examines the potential of historical documents from Wales to provide a detailed reconstruction of climate variability and weather extremes during the last several hundred years. Such a record would provide valuable information from the western fringes of Britain, known for its sensitivity to variations in the North Atlantic (Mayes, 2000).

The 1877 volume of British Rainfall listed 96 precipitation monitoring sites in Wales. Most sites were located in lowland towns and cities, resulting in poor representation of upland and rural areas (Symons, 1878). Documentary records offer considerable potential for developing a better understanding of climatic variability in rural regions, and in particular the frequency and magnitude of extremes and other notable events (Brazdil *et al.*, 2005). In Wales, there has been little detailed assessment of the climate record from historical documents, with Oliver (1958; 1967) providing brief reviews of agro-climatic source materials, and recent work by Haslett and Bryant (2007) focused on the identification of earthquake-related tsunami events around the Welsh coast. Limited analysis of the historical climatology of Wales has perhaps been undertaken as sources are often recorded in Welsh, or a mixture of English and Welsh, which are unreadable by many. Historical sources are often widely dispersed (unless contained within special collections), increasing the difficulty in locating them; accessing and understanding these sources – even the terminology within the accounts may be regionally specific – presents challenges in defining the exact account meaning. Given the wealth of documents housed in the National Library of Wales, along with numerous regional archives, it is perhaps surprising that previous studies addressing historical climate analysis within the UK have overlooked the potential contribution of sources from Wales. The National Library of Wales manages one of the largest collections of Welsh language literary and history collections in the world. Within these accounts are numerous sources discussing weather and climate, often in a descriptive manner as a tangential point to the main focus of the document, but occasional sources directly chronicle the weather or climate. The wide variety of sources includes personal diaries, farm and estate records, council and parish records, and even poetry and ballads.

In this article, we identify a series of key texts (Table 1) from a preliminary investigation of documentary materials from Welsh, English and bilingual (or macaronic – where multiple languages are used interchangeably within the text) sources relating to weather and climate in Wales. The selection of texts presented here is designed to illustrate the range of archival sources that are potentially available, and is thus neither

Table 1

Chronological sequence of the principal sources examined to date.

Name/type of Source	*Start*	*Finish*	*Description of weather records*
Annales Cambriae	682	954	Intermittent
Brut y Tywysogion	684	1330	Intermittent (The Chronicles of the Princes)
Giraldus Cambrensis	1188	1188	*Tours of Wales*
Carreglwyd Estate Records	1329	1864	Intermittent
I'r Haf Oer 1555	1555	1555	Poem on one specific year
Summer Carols	1625	1776	For a specific summer and/or the previous winter
William Thomas	1762	7 April 1795	Daily diary entries
Thomas Pennant	1773	1781	Travelogue
Dafydd Wiliam of Llandeilo	1785	1785	Ballad on one specific year
Daniel Walters	1780s		Daily diary entries
Walter Davies (Gwallter Mechain)	1797	1846	Daily diary entries (intermittent) and Reports
Printed Ballads	Eighteenth Century		For a specific year
D. O. Jones	1 Jan 1934	31 Jan 2000	Daily diary entries

RMetS Royal Meteorological Society

chronologically continuous, nor exhaustive. A Welsh language dictionary of current and past regional terms for different types of weather is presented (Appendix 1, after the References); if you are aware of terms not included please contact the authors. We consider how this pilot study of historical records from Wales can be further developed to provide new insights into weather and climate variability on the fringes of the North Atlantic and into the nature of social responses to climatic extremes.

Wales and the weather

The topography of Wales, although generally hilly throughout, consists of three main upland areas. In the south, running west to east are the Brecon Beacons (Bannau Brycheiniog) and the Black Mountains (Y Mynyddoedd Duon), whilst the Cambrian Mountains are oriented in a north–south direction through mid-Wales. The highest mountains are to be found in the north-west of the country, with several peaks over 1000m, including Snowdon (Yr Wyddfa), the highest mountain in England and Wales. Topography presents an important control in determining regional and local weather, with a strong rainfall gradient evident along much of the west coast, reflecting the steep relief. Over three-quarters of the Welsh border is defined by coastline, making the country highly sensitive to changes in the prevailing westerly mid-latitude circulation systems originating over the North Atlantic.

The North Atlantic Oscillation (NAO) has a strong relationship with precipitation: during positive NAO phases winters are typically wet and mild, whereas during the negative phase they are drier and colder (Hurrell, 1995; Hurrell *et al.,* 2001). The increase in precipitation is brought about by an increase in the occurrence of Atlantic-born depressions in the strong westerly airflow (Wheeler and Mayes, 1997).

Agriculture has historically played a vital role in the economy of Wales, particularly in rural areas where communities have a strong link with the natural environment and its variability. Approximately 80% of land is designated as *less favourable* according to the EU (this designation is based on both socio-economic and environmental factors). The sensitivity of farming communities in west Wales to climatic variability is highlighted by the devastating impact of the 1946/1947 winter, the snowiest on record. Severe snowstorms in January, February and March 1947 caused the loss of large numbers of sheep in the mountains of mid-Wales leading, for example, to permanent abandonment of farmsteads in the upper Tywi Valley (Jones, 2007). Sheep farmers in the region also suffered considerable losses during earlier harsh winters in 1814 and 1895 (Howells, 2005). There is a strong contrast between the upland and lowland regions of Wales. The uplands are at the margins of commercially viable farming and largely given over to hill sheep farming, whilst lower-lying coastal and alluvial areas are much more fertile and productive with more favourable climatic conditions. Until the late eighteenth century, a form of transhumance was common practice across Wales (some regions of the Cambrian Mountains are still farmed using this practice). During the summer months, farmers would move to their summer residence (*hafod*) and graze their animals in the mountains. During the winter months, animals were brought down to shelter in valleys and coastal areas, the farmer relocating to the main residence (*hendre*, meaning 'old dwelling'). Today many homes across Wales retain the links to the historic transient farming practices, with many buildings retaining *hafod* or *hendre* within the property name.

Sources

The political history of Wales has significantly influenced the spatial distribution and types of documentary material recorded in Welsh, English, or a mixture of the two languages. Initially invaded and suppressed by Edward I in the thirteenth century, Welsh rebellions were not uncommon and are recorded until the sixteenth century (Davies, 1994). The invasion and subsequent subjugation of the populace resulted in a strong Welsh identity. As a result, local history is often recorded in Welsh (or retold through the Welsh language), whilst official (governmental and legal) records are in English (or Latin/French). Over time this resulted in educated Welshmen writing in both English and Welsh. Numerous accounts reflect this bilingualism, such as the writings of Iolo Morganwg 1747–1826 (Charnell-White, 2007) and the letters of the Morris brothers of Anglesey (Davies, 1907; Johnston, 1993).

The spatial distribution of dialects, the absence historically of a single defined spelling for many words and terms (e.g. flood: *llifiad; llifad; llifiant; llifant*), the use of alternative words in differing regions (e.g. hail: *cesair* used in the south, but *cenllysg* in the north), and the evolution of words (e.g. frosty: *rhewllyd; rhewlyd* (fourteenth century); *rhewaidd* c. 1730; *rhewog* 1773; *rhewol* 1837; *rhewin* (eighteenth–nineteenth centuries)) – the dates provided are of earliest attestations – increased the complexity of compiling and analysing the historical accounts. These issues represent a considerable challenge in the analysis of source materials. Therefore a dictionary of weather-related terms was constructed to facilitate this research and aid in the recognition of unfamiliar language, whilst recording the spatial and temporal variability, allowing a quicker and more reliable determination of different weather descriptions in the future. It is anticipated that the dictionary will develop and evolve as the research expands through the examination of further texts. Whilst monastic records have not been considered to date, they may potentially provide a valuable dataset for future study. A review of a selection of key sources considered to date follows.

Geographical descriptions and travelogues

The earliest description of the topography of Wales is that of Giraldus Cambrensis. Born in 1145 at Manorbier in Pembrokeshire, Gerald of Wales, as he has become known, was part Welsh and part Norman. He was very well connected with the higher echelons of both English and Welsh society and travelled extensively. He wrote two books relevant to Wales: a diary based on his tour of Wales in 1188 and a description of the geography and social and economic conditions in Wales. These represent a unique insight into Welsh life at the close of the twelfth century. Most of the references in these accounts describe more general climatic conditions. For example, around Llanthony, the climate is described as *temperate and healthy, the air soothing and clement*. However, there are occasionally more specific references. Here, he describes the impacts at Newgale Sands in Pembrokeshire of a terrific storm that battered the coast of Wales in 1171/1172:

> *The wind blew with such unprecedented violence that the shores of South Wales were completely denuded of sand, and the subsoil which had been buried deep for so many centuries, was once more revealed. Tree trunks became visible, standing in the sea with their tops lopped off, and with the cuts made by the axes as clear as if they had been felled only yesterday…the sea shore took on the appearance of a a forest grove, cut down at the time of the Flood… The tempest raged so fiercely that conger-eels and many other fish were driven up on the high rocks* (Gerald of Wales, 1978).

Gerald also provides us with an insight into the types of agriculture being practised. The County of Brecknock, for example, *produces a great amount of corn*. Interestingly, Gerald notes that supplies were often brought in from the neighbouring part of England during times of shortage, an example of cooperation in response to stress. Similarly, referring to the notable fertility of the island of Anglesey, Gerald states that *when crops have failed in all other regions, this island, from the richness of its soil and its abundant produce, has been able to supply all Wales*. An abundance of wine for sale is referred to around Gerald's birthplace of Manorbier (Pembrokeshire), although this does not necessarily indicate warmer climatic conditions.

During the late 1700s, the aesthetic ideals of the Picturesque rose to prominence, leading to an increase in people travelling for scenic pleasure through the British Isles. Thomas Pennant was one of the first authors of many travelogues describing Wales in the eighteenth and nineteenth centuries. He has been referred to as *the Father of Cambrian Tourists* by a later traveller, William Catherall, in 1851. Pennant's *A Tour in Wales* was published in two volumes and based largely on three separate journeys between 1773 and 1776, produced initially in 1781 and 1783. Unfortunately, most descriptions are not dated and whilst regular flooding is mentioned, again specific locations and dates are not given. However, a major flood at Llanuwchllyn, near Bala, on 20 June 1781, which affected large parts of North Wales, is described in some detail through the insertion of a newspaper account. The River Twrch, which flows from Bwlch y Groes into Llyn Tegid (Bala Lake), burst its banks following a torrential downpour, with huge stones transported, livestock swept away and much of the village of Pandy destroyed. Pennant notes that on the same day, the river at Ruthin (River Clwyd) rose *to an amazing height* and claimed that *there never was known so general a deluge in these parts by the oldest inhabitants* (Pennant, 1810). This incident is referred to in numerous other travelogues from the early nineteenth century. Pennant appears to be the main source for the information in these sources, highlighting the need for caution when using multiple sources for cross-validation.

Poetry

I'r Haf Oer 1555 (The cold summer of 1555)

I'r Haf Oer 1555 is a unique poem detailing the cold summer of 1555; it provides an early source specifically addressing the weather in Welsh. This poem belongs to the realm of formal strict-metre poetry which was the preserve of the gentry in Wales. It owes its survival to two novelty factors: that it was composed by a woman and its remarkable subject matter.

I'r Haf Oer, 1555
Gwynt buan, cadarn a'r coedydd – ar drallod
Yn dryllio dail newydd;
Nid gwres o des un dydd
Ond troi gaeaf tragywydd.

Gwynt glaw a ddaw mor ddifri – a chenllysg
A chynllwyn pob oerni;
Am waith Duw ni waeth dewi,
Gaeaf yn lle haf yw hi.

Gwyliwch ryfeddod, mi a goelia' – beth
Ni wn byth, a'i gwela';
Mae gwynt oer fel gwynt eira
Mewn camamser hanner ha'.

Y ffordd gan Ferddin, ŵr ffraeth – a chwilied
Ni choeliwn ni 'sywaeth;
Fo droes un y drudaniaeth,
Fo dry'r byd i gyd yn gaeth.

Cathering verch Gruff: ap Howel ai k.'

To the cold summer, 1555
Swift, strong wind and the trees – in distress
Scattering new leaves;
There is no heat from the sunshine [for even] one day,
Only eternal winter.

Driving rain and hail come so earnestly,
Plotting all kinds of coldness;
It is not worth keeping quiet about God's work,
It is winter instead of summer.

Beware the wonder which I see – I believe
In the thing which I've never come across before;
There is a cold wind like snow wind
Mistimed [in] mid summer.

Merlin's way, the eloquent sorcerer, was sought,
Alas we don't believe in it;
This madness has confined one/me,
[And] it is holding the whole world captive [too].

Catherine daughter of Gruff: son of Hywel sang this

(Modern Welsh version of *I'r Haf Oer 1555* edited by C. Charnell-White, English translation by C.A. Jones.)

Carolau Haf (Summer carols) and Dafydd Wiliam's poem of the dry summer of 1785

The *Carolau Haf,* or *Summer carols,* represent a series of individual recollections recorded within the form of a *carol* (song); over fifteen of these sources exist between 1625 and 1776. The carols cover a specific region, often a town or village. Generically, they describe the summer in the context of the previous winter, and so provide a valuable insight into the general climate for the given year. Carols have been identified from three principal regions: two areas in north Wales reflecting the area around Trefriw (Snowdonia) and Ystrad Alun (a commote near Mold – commotes were districts under Norman rule, lying west of Offa's Dyke, but subject to Welsh laws and customs) and, in central Wales, Y Pandy, Trerhiwedog (now spelt 'Tregeiriog'). The summer carols are individual pieces, with no single source drawing them all together; as such it is likely that more accounts of this nature have been recorded, and as yet remain unidentified.

Other popular literary sources refer to climatic extremes, including the printed ballads of the eighteenth century. For example, the dry summer of 1785 is depicted by the hymnist, Dafydd Wiliam of Llandeilo Tal-y-bont, as follows:

Dyma'r crop, a thyma'r ffrwythau, *Gal. 6. 8.*
Mae ein pechodau yn ei ddwyn;
Yr had a hauir hwnnw fedir, *Rhuf. 2. 6.*
Medd y 'sgrythur, heb ddim cwyn;
Mae Duw â'r crymman o gyfiawnder, *2 Cor. 9. 6.*
Gwres a phoethder haf-ddydd brwd,
Sychu 'fonydd, gwiwo'n coedydd,
Difa'n ffrwythydd a'n holl gnwd. *Rhuf. 8. 7.*

(*Here is the crop, here are the fruits brought about by our sins; the scripture tells us that we reap what we sow; God with his sickle of righteousness – the warmth and heat of a summer's day – is drying rivers, wilting woods, ruining all our fruits and yield*) (Translation C. Charnell-White).

It is interesting to note the clear link between the vagaries of the weather and divine retribution, a common theme throughout numerous similar sources.

Taken in isolation, these records cannot be considered reliable descriptions of weather. However, they do point to individual events which were significant enough to be recorded in popular literature. These may provide a reference point for comparison with other sources from the same time period. Furthermore, these poems and hymns provide an insight into prevailing perceptions of the weather and extreme events.

Personal diaries

The diaries of William Thomas and Daniel Walters

The diaries of William Thomas (1727–1795) provide a valuable insight into the weather of the late eighteenth century (1762–1795) in the Vale of Glamorgan. The diaries record many aspects of everyday life, with a particular focus on local people and activities, as well as the weather. The diaries start in 1762 and reflect the towns and villages within which William Thomas lived as a schoolmaster; earlier diaries are likely to have been written and have subsequently been lost. An abridged and edited version of the writings of William Thomas was published by Denning (1995), but this version omitted many of the discussions concerning the weather contained within the original manuscripts. Microfiche copies of the original scripts were examined to document weather-related comments.

The diaries of Daniel Walters (1762–1787) describe the weather in the Vale of Glamorgan during the 1780s. Daniel Walters was educated in Oxford and returned to Glamorgan to take the position of teacher,

and subsequently Head, of Cowbridge Grammar School (Warburton, 1985). The writings of Daniel Walters are better known for the detailed correspondence with Iolo Morganwg (the bardic name of Edward Williams: 1747–1826) during this period. That these two sets of diaries represent an overlapping time period means cross-validation is possible and greater confidence can be placed in any climatic reconstruction over this time period.

The diaries of Walter Davies (1761–1849)

Walter Davies (also known by his bardic name of Gwallter Mechain) was an educated Welshman, born in Montgomeryshire and educated at Oxford and Cambridge. Commissioned by the Board of Agriculture in 1797 to undertake a survey of the economic situation of North Wales, his remit was later broadened to encompass the whole country. His findings were published in three volumes in 1810 and 1815 (Davies, 1810, 1815a, 1815b). Throughout his life, he travelled widely throughout Wales, often recording information concerning the general weather (Figure 1) and describing notable events within his diaries and field notebooks.

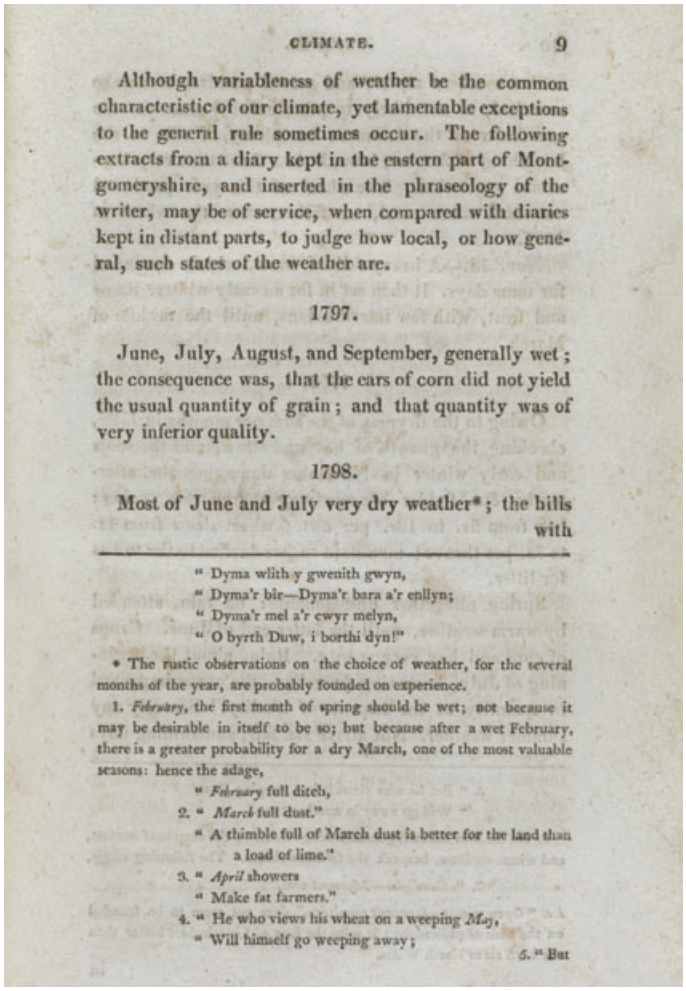
> *After an uncommon wet summer, Harvest and Autumn, much dry weather was anticipated in Winter, when in common apprehension Dry weather at that season would have been frosti but not so. A nights frost, or two, maueby three was all we have yet had; and even then it thawed in the day time. Which is auon led for by meterorologists on the theory that wet earth is a greater conductor or preserver of heat in the interior of the earth than a dry earth* (Walter Davies, Winter 1821).

> *The highest flood in the Rhiw I ever saw. In April 1808 there was a very high flood: but this is several inches higher. To find a greater flood we must go back to the Rodney Hurricane and flood in the year 1782.* (Walter Davies, 6 March 1822.)

The weather chronicle of D.O. Jones (1934–2000)

The diaries of D.O. Jones are the most recent documents considered. His chronicle records the weather around his family farm at Ysbyty Ifan in the upland region of northwest Wales (near Bala) from 1934 until his death in 2000. The diaries include daily descriptions of the weather for the duration of this period, with comments relating to the daily running of the farm and the weather. The accounts are predominantly recorded in Welsh with occasional English sections; of particular note are the comments made concerning the winters of 1947 and 1963 and the summers of 1976 and 1988 (an excerpt is shown in Figure 2). The diaries of D.O. Jones are of particular interest as they cover a period in which many catchments started to provide instrumental data (1960s–), allowing the documentary accounts to be analysed in comparison to the instrumental series to examine the reliability of the records and suitability for past reconstruction.

In order to produce a time series of climatic variability, information from documentary accounts needs to be classified into a series of indices (numeric form) for analysis; previous studies have applied this approach to climatic (Pfister *et al.*, 1999) and fluvial (Brazdil *et al.*, 1999) accounts. The information contained in the diaries of D.O. Jones was converted into a series of indices (Table 2) using the approach applied by Gimmi *et al.* (2007) and compared to the mean daily gauged river-flow records from nearby catchments. Two time slices are considered to examine the suitability of the



CLIMATE. 9

Although variableness of weather be the common characteristic of our climate, yet lamentable exceptions to the general rule sometimes occur. The following extracts from a diary kept in the eastern part of Montgomeryshire, and inserted in the phraseology of the writer, may be of service, when compared with diaries kept in distant parts, to judge how local, or how general, such states of the weather are.

1797.

June, July, August, and September, generally wet; the consequence was, that the ears of corn did not yield the usual quantity of grain; and that quantity was of very inferior quality.

1798.

Most of June and July very dry weather*; the hills with

" Dyma wlith y gwenith gwyn,
" Dyma'r bir—Dyma'r bara a'r enllyn;
" Dyma'r mel a'r cwyr melyn,
" O byrth Duw, i borthi dyn!"

* The rustic observations on the choice of weather, for the several months of the year, are probably founded on experience.

1. *February*, the first month of spring should be wet; not because it may be desirable in itself to be so; but because after a wet February, there is a greater probability for a dry March, one of the most valuable seasons: hence the adage,
" *February* full ditch,
2. " *March* full dust."
" A thimble full of March dust is better for the land than a load of lime."
3. " *April* showers
" Make fat farmers."
4. " He who views his wheat on a weeping *May*,
" Will himself go weeping away;

5. " But

Figure 1. Excerpt from the diaries of Walter Davies (Davies, 1810). (By permission of Llyfrgell Genedlaethol Cymru/The National Library of Wales).

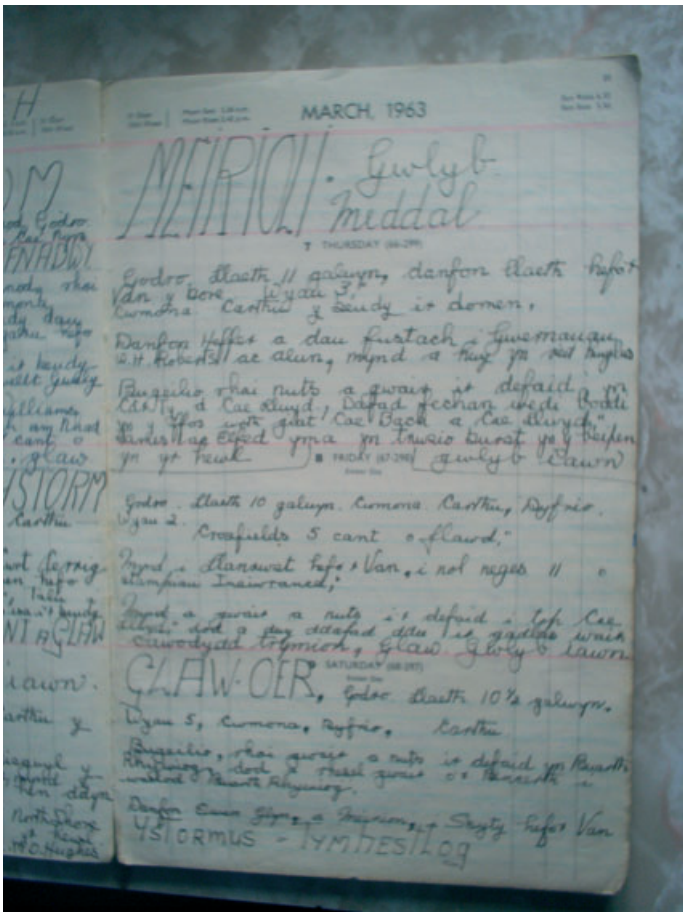


Figure 2. Account from the diary of D.O. Jones from 6 to 9 March 1963.

approach: the periods 1976 and 1988 are given as they represent a dry summer with a wet September (1976), and the wet summer season of 1988. These are both identified as representing extreme seasonal examples within the UK (Figures 3 and 4).

Table 2

Weather indices (the numerical range applied in Figures 3 and 4).

Weather type	*Indicies value*
Drought / Hot	0
Dry / Fair / Close	1
Drizzle / Foggy	2
Showers	3
Rain / Wet	4
Storm	5

The accounts from the summer of 1976 (Figure 3) relate well to the gauged river-flow records, but the river-flow records for the summer of 1988 appear to correlate poorly against documentary accounts, and particularly the 'storms'. Further analysis of the diarised accounts clarifies this, as the diaries often state that days would be warm and dry with afternoon or evening storms. The disparity between the evening storms and dry days raises a concern when considering historical records detailing the weather. In assessing a historical account, consideration of the recorder's motive is often important, as this often helps to determine the reason for the record; in assessing a farmer's diary, it should be anticipated that events that may directly impact upon the farmer (e.g. the storm that damaged crops) will be chronicled in greater detail compared to a dry humid day that represents the seasonal normal. The descriptions of storms within the accounts reflect the nature of convective summer storms, which, although intense, would rarely cause an increase in flow within lowland rivers (most of the river gauges are located in lowland reaches), hence the relatively low flows compared to the severity of the description. An understanding of the likely generating mechanisms and the spatial and temporal extent of the weather events can also play an important role in the likely impact of an extreme event on the region. The diaries of D.O. Jones provide a valuable tool in verifying the value and confidence that can be placed within descriptive accounts. This preliminary analysis also highlights some of the aspects (e.g. recorder focus) that may provide a misrepresentation if the context in which they were written is not carefully considered.

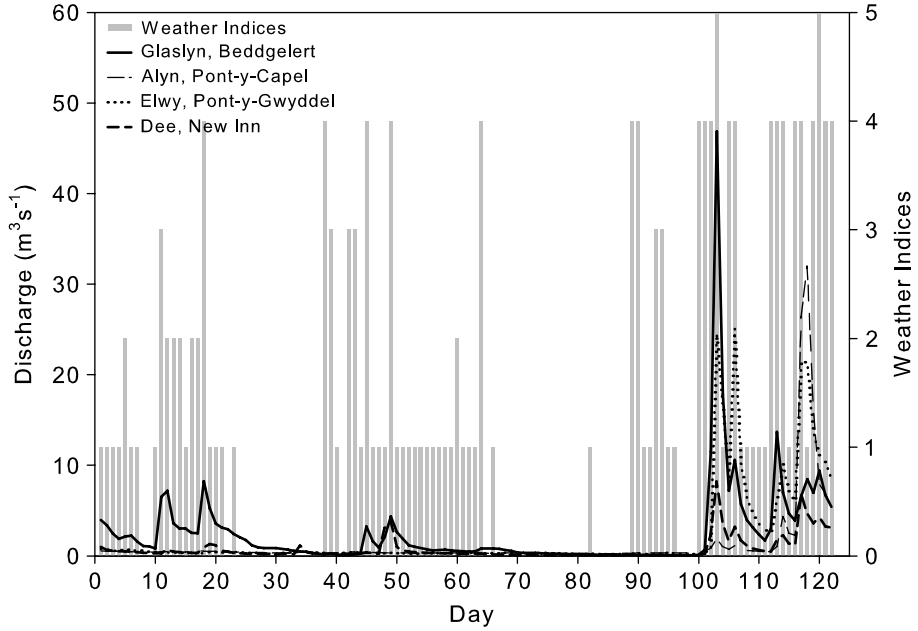


Figure 3. Relationship between weather indices and regional river discharge (1 June – 30 September 1976).

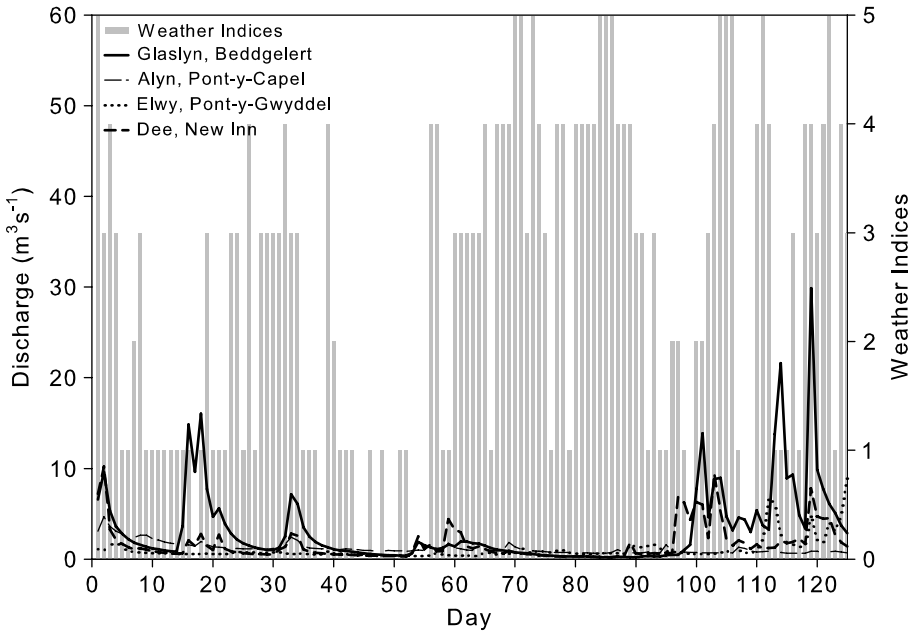


Figure 4. Relationship between weather indices and regional river discharge (1 June – 30 September 1988).

Discussion

Diaries are regularly maintained on farms for several generations reflecting the close relationship between farming, environment and particularly the weather, and as yet represent an untapped resource in considering past weather and climate. Diaries are of particular interest in remote areas where good instrumental coverage is unlikely until the late twentieth century.

A wealth of documentary information remains to be examined for Wales, with a considerable number of sources known to contain weather and climate information that, to date, have not been analysed. The potential for documented accounts within farming communities is considerable, but as yet barely examined. Although some documentary accounts overlap with the instrumental period, few long instrumental series exist in many rural areas; in these regions documentary accounts provide a valuable tool. Since embarking on this project, we have become aware of numerous similar records; these are widely dispersed and often in private family collections. Personal diaries, such as those of D.O. Jones, contain considerable amounts of information, but often contain family details and comments of a deeply personal nature, and as such represent important heirlooms to surviving family. In some cases extensive reviews of diaries may not be possible or appropriate due to the potential intrusion to the family. However, with due consideration to such ethical issues and agreed co-operation from families, these sources have the potential to yield valuable information on climatic variability and social responses to environmental change.

Estate records are a logical development from the journals of individual farmers; extensive work has been undertaken on such sources within Europe (Brazdil *et al.*, 2006b). Numerous estate records are found within the archives of the National Library of Wales, as well as in regional archives across the country. In some cases, documents relating to a particular estate date back several centuries. For example, papers from the Carreglwyd Estate on Anglesey, housed within the National Library of Wales, cover the period between 1329 and 1864. The type of information available within individual estate records is variable, but may include personal correspondence, bills and accounts and farm records along with title deeds and other legal documents. A systematic investigation of estate records will form an important part of the next phase of this project. The Archives Network Wales (www.archivesnetworkwales.info) is a searchable database, providing a helpful means of identifying potential sources in both regional and national archives. This is a valuable resource, but there are likely to be many more undiscovered opportunities dispersed widely in private collections.

Conclusions

This article has focused on the preliminary findings of a pilot project, which has identified that a considerable amount of material exists documenting past weather and climate in the Welsh language within the British Isles, with a few key texts examined here. The analysis of periods where both documentary and instrumental series exist has exemplified the potential value of documentary accounts as a tool for understanding past weather and climate and increased confidence in extending the record further back in time. Future work, enabled by the awarding of a Welsh medium postgraduate studentship to Cerys Jones at Aberystwyth University, will address the issues raised by this article and further expand the current dataset, which to date includes over 2500 entries between the twelfth and the twenty-first century. Another future development will be to broaden the scope of the project to examine the nature of social responses to changing environmental conditions and climatic extremes. In particular, we plan to compare records from upland and lowland regions in Wales to examine their differing sensitivities.

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Appendix 1

English–Welsh weather dictionary (with regional dialects/variations), compiled using Geiriadur Prifysgol Cymru *at www.aber.ac.uk/geiriadur*

Arid	**Cras, sychder, sychgras**	
	Aridity	crasineb, crinedd, poethwg, sychdwr
Autumn	**Cynhaeaf, cynhaef, echwydd (ŵy), elfed, hydref, hyddfref, hydrew, mesyryd, syrthiad y dail**	
	Autumnal equinox	Alban Elfed, cyhydedd (y) cynhaeaf, cyhydnos yr hydref
	Autumn fallow	Braenar Mihangel, branar Mihangel, brynar Mihangel
	Autumnal	Cynaeafaidd, cynaeafol, hydrefol
	Autumn wind	Hydrefwynt
	Wet Harvest	Cynhaeaf brith
Dry	**Caledu, celffeinio, clyd, cras, crasineb, craslyd, crimstio, crimstennu, crino, di-ddŵr, diddwfr, diffrwytho, dihysbydd, dyhysbydd, di-nodd, dinodd, dysychu, disychu, gogrisbin, gwyw, hyglyd, hysbydd, hisbydd, sbyngllyd, ysbyngllyd, sych, sychedig, sychiedig, sychgola, sychlyd**	
	Dry weather	Hindda, himdda, hinda, sychin, teg
	Dryness	Agarwedd, hysbedd, sychder, sychdod, sychdra, sychdwr, syched, sychedfod
	Dry land	Crastir, Daearlan, sychdir, tir coch, tir cras, tir sych
Drought	**Gwresog, poethni, sychder, sychdod, sychdwr, syched, sychedfod, sychin**	
Earthquake	**Crynfa daear, crynfa'r ddaear, daear gychwyn, daeargryd, daeargryn, daear grŷn, daeargrynedigaeth, daeargrynfa, daear grynfa, daeargryniad, daear gryniad, dirgryniad, terfysgiad**	
Fog / mist	**Caddug, ceden, crwybr, cwybr, ffasach, ffaslas, ffóg, ffeg, ffogen, mwrl, mwrllwch, mygdarth, mwgdarth, nifwl, niwl, niwyl, niwlach, niwliach, nudd, smwcan, ysmwcan, tarth**	
	Foggy / misty	Caddugaidd, cadduglyd, caddugol, ffoglyd, mwll, mwrlaidd, myglyd, mwglyd, nifwlog, nifylog, niwlog, niwliog, tarthlyd, tarthog, tarthiog
Flood (a)	**Aches, adlif, anlloedd, anlloeth, anllwyth, anoddun, anoddyn, bawdd, boddfa, cefnddwr, cefnfor, cenlli, cenllif, cefnllif, cyfor, dilyw, diliw, dŵr mawr, dyfrlif, dyfrllif, dylad, dylif, dylifiant, ffrwd, glawddwr, glawddwf, gorddwr, gorddwfr, gorlanw, gorllanw, gorlif, gorllif, gorlifiad, gorllifiad, gorlifiant, gorllifiant, gweilgi, gwylltlif, hèg (in river), llanw, lliant, llif, lli, llifair, llifddwr, llifddwfr, llifeiriant, llifddeiriant, llifiad, llifad, llifiant, llifant, mordwy, rhedlif, rhuthrlif, rhyferthin, rhyferthwy(ad), trenllif, ymchwydd**	
	(to) flood	Boddi, dilywio, dylifo, llifeirio, llifhau
	Flood-water	Dŵr llwyd
Frost	**Chwipio rhewi (to freeze hard), crimprew, iâ, iaeth, iaaeth, rhew, tanr(h)ew (severe)**	
	Frosty	Iaeth, iaaeth, llwydrewlyd, llwydrewllyd, rhewaidd, rhewin, rhewllyd, rhewlyd, rhewog, rhewol
	Hoar-frost	Arien, barrug, crwybr, cwybr, glasrew, gorewi, gorwydr, iâ, iaf, llwydrew, llwytra, llwytro
	Free from frost	Gwresogwlyb
	Jack Frost	Jac y Rhew, Siôn Barrug
Hail	**Cenllysg, cenllyst, cynllysg, cenllysglaw, cesair, ceseirlaw (mingled with rain), cesirio**	
	Hailstone	Carreg genllysg, carreg gesair, cenllysg, cynllysg, cesair, maen cenllysg
Ice	**Durew, iâ, rhew**	
	Icy	Durew, iaeth, iaaeth, rhewaidd, rhewllyd, rhewlyd, rhewog, rhewol

(*Continued*)

Appendix 1 (*Continued*)

English–Welsh weather dictionary (with regional dialects/variations), compiled using Geiriadur Prifysgol Cymru *at www.aber.ac.uk/geiriadur*

Lightning (to flash)	**Ffleimfellt, bwrw golau, fflachiad mellten, gwreichioni mellt, llethrid, lluchedu, lluchedennu, melltennu, mellt(i)o, melltu, saethu mellt, taflu golau, taflu tân, taranfollt(i)o**	
	Sheet lightning (unaccompanied by thunder)	Awyrddraig, draig, planedo
	Flash of lightning	llucheden, lluch(i)aden, llecheden, lluchedeniad, lluchediad, maen cawod (cawad), mellt, mellten, myllt, melltenaid, melltluched, post
Rain	**Glaw, glawogydd, adlaw, cawod, cawad, cafod, cymunlaw**	
	Begin to rain	taflu dafnau
	To rain and blow a high wind at the same time	Chwiwio bwrw
	Hail/snow with rain	Ceseirlaw [hail], glaw eira [snow]
	April rain	Glaw tyfu
	Brew for rain	ceulo am law
	Early rain/first rain	cynharlaw, cynnar-law
	Likely to rain	clafaidd
	Rain drops	clych glaw, dafnau glaw, dagr, degryn, deigryn, deigr, glaw bras [large]
	Heavy downpour of rain	Arllwys (y glaw), diffwys, diffwyster, diwel y glaw, diwelaf, diwin, glaw gochel, glaw gyrru, glaw tyrfau, glaw tarannau, hirlaw, horslaw, hyrddlaw, llyfreirlaw, pelt(i)o, pistyll(i)o, pistyllu, pistyllian, rhuthrlaw, curin, curing, cyrin, curlaw, curlawiog, glaw gyrru, glaw 'Stiniog (Ffestiniog), yn ei dymchwel hi, pis(i)o bwrw (glaw), ponlaw, rhyslaw, slasio bwrw (glaw), stid(i)o bwrw/glawio, tatsio, tatsian, tresio, tresian bwrw (glaw), bwrw hen wragedd a ffyn (cats and dogs), bwrw cyllyll a ffyrc(s)
	Gentle/drizzling rain	gwlith(i)o, gwlithen, gwlithgawod, gwlithgawad, gwlithlaw, ffrechan, ffrechen, lleithrin [weather], lleith-hin [weather], pigo, pigan, pigach, sgip, smitlaw, briwlaw, glaw mân, glaw smwc, glaw mynydd (on highlands), manlaw, mân law, piglaw
	Abundance of rain	Hidlaidd, hilaidd
	Steady rain	gwastadlaw
	Layer of frozen rain	glâsrew
	Frozen rain	glaw iâ
Rainbow	**Bwa, bwa enfys, bwa'r glaw, bwa'r cyfamod, bwa'r Drindod, bwa'r hin, bwa'r wrach, bwa'r wybren**	
	Partial rainbow	Cyw drycin
Sleet	**Eirlaw, glaw eira, glaweir, llifeirlaw, odlaw, slap, slot eira**	
	(to) sleet	Odi
Snow	**Eira, eiraf, eiry, nyf, Briwod (fine-driven), cribod (surface), cynneiry (first fall of), ffluwch, ffluch, gwyneiry, gwynneiry (white/blessed), manod (fine-driven), nithod (fine), ôd, odi, odif**	
	Snowflake	Casnod, casna(d)d, clwyden o eira, fflochen, ffloch, hiff, hyff, ôd, tafell
	Snowball	Caseg eira, mopen, pêl eira, plu(f) eira
	Snow-drift	heod, lluch, lluchfa, lluchiad, lluwch, lluwchyn, llywch, lluwchfa, llochfa, lluwchiad
	Rain mingled with snow	Glaw eira
Spring	**Cyntefin, eilir, gwanwyn, gwaeanwyn, gwanhwyn, sbring, ysbring**	
	Spring fallow	braenar gwanwyn, branar gwanwyn, brynar gwanwyn

(*Continued*)

Appendix 1 (*Continued*)

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Storm	**Brochell, brythwch, cwthwm, gwthwm, cwthwn, gwthwn, rhyferthwy, storm, ystorm, stormen, (y)storm(i)o, (y)stormi, tymestl, temestl, temhestl, temest, tempestl, temystl, ystorm, ystormo, storm**	
	Stormy (weather)	Corwyntog, dihinedd, dyhinedd, drycin, drycinllyd, drycinog, drycinol, egr, garw, gerwinol, gerwiniol, gwyllt, gwyll, gwynnog, gwnnog, gwyniog, gwyntog, gwyntiog, hagr, hyll, hyllig, mawr, rhyferthwyol, stormllyd, ystormllyd, (y)storm(l)lyd, stormus, ystormus, stryllwch, taranllyd, tranllyd, terfysg, trwblaethus, trwbliaethus, trwbledig, trwbliedig, trybliedig, trwblus, tryblus, tymhestlawn, tymhestlog, temhestlog, tempestlog, tymhestlol, tymhestlus, tyrfus, tywydd, ysgithrog, sgithrog, (y)sgythrog, sgethrog, ysgethrog, ystormedig, stormllyd, stormus, ystorml(l)yd, tymestlogrwydd
	Winter storm	gaeafrawd
	Storm at sea	Gweilgi, mordwy
	Blow a storm	gorddyar,-u
	(to) brew a storm	Darllaw, magu storm
Summer	**Haf, hafgwaith, hefin**	
	Summery weather	Gwresog, haf bach (gŵyl) Mihangel [around Michaelmas, 29th September], hafol, mandes gŵyl Mihangel [around Michaelmas / Indian Summer], tes Mihangel [Indian summer]
	Wet summer	Haf brith [partly dry but mostly wet]
	Summer solstice	Alban Hefin, heuldro'r haf, haul-orsaf (yr) haf, heulorsaf (yr) haf, hirddydd haf
	Unsummerlike	Anhafaidd
	Summer fallow	Braenar haf, branar haf, brynar haf, hafar, hafra, hafru, hafarddu
	Midsummer Eve (23rd June)	Noswyl Ieu(w)an (hanner haf), nos ŵyl Ieu(w)an (hanner haf)
	Midsummer (24th of June)	Calan Ieuan Fedyddiwr, calan haf, dygwyl Ifan, dyddgwyl Ifan, dywgwyl Ifan, gŵyl Ieuan (Ifan) hanner (yn yr) haf, hanner haf, hirddydd haf
	Beginning of summer (1st of May)	Calan Mai, C(a)lanmai, Clamai, cyntefin (May)
Sun	**Cannaid [in North Wales formerly], cannwyll, haul, heul, heulyn, heulwen, haul-wen, huan, hyfelydd, lamp, llamp, lleufer, lleuer, llefer, llygad y dydd, llygad (y) goleuni, sol, sul**	
	Sunrise	Codiad haul, cyfodiad haul, gwawr
	Sunset	Achlud(d) yr haul, caer haul, cynnu, cyrraedd ei gaearu (am yr haul), digwyddo, dygwyd(o), digwyddedigaeth, gostwng haul, gostyngiad yr haul, haddau, haddef, (myned) haul dan ei gaerau, llewenydd, llywenydd, machlud haul, machluta, machludiad (yr) haul, machlad, machliad, machladiad, machlydu, machludd, ymachludd(o), ymachlud(o), ymachluddio
	Sunless	Anaraul, diaraul
	Sunny	Araul, arheul, braf, brwd, hafin, hefin, heulaidd, heuldeg, heulol, heulog, heuliog, heulwedd, heulwennog, heulwennol, hinonaidd, huan, hydes, llathraidd, tesog, tesol, heulwenddydd [day]
Thunder (to)	**Gwneud trwst (trystau), taran, taranadu, taranu, tranu, trwst, trws, trybowndio, trybowndian, drybowndio, drybowndian, tryst(i)o, trystian, trwstio, trwstian, twrdd, twrddan, twrddanu, tyrddu, twrddo, twrdd, tyrddan(u), twrf, twrw, tyrfu**	
	Thunderbolt	Bollt, bollten, bollt taran, carreg daran, carregtaran, maen cawod (cawad), maen mellt(en), maen taran (y daran), malltan, melltan, mylltan, taran, taranfollt
	Thunder-clap	Dyrnod taran, marchdaran, taran, taraniad, taranad
	Thunder and lightning	Mellt a tharannau
Tornado	Gyrwynt, hyrddwynt, tornado, tornedo, trowynt, troewynt	
Tsunami	-	
Wave	**Defaid Dafydd Jos (waves), defaid Gwenhidwy, distrych, dylan, geirw, gwaneg, gwanegiad, gwendon, gwrym, hoywdon, llanwdon, llion, meirch Gwenhidwy, merin, mordon, môr-gaseg, môr-waneg, ton, ton lawn, tonial, toniar**	

(*Continued*)

Appendix 1 (*Continued*)

English–Welsh weather dictionary (with regional dialects/variations), compiled using Geiriadur Prifysgol Cymru *at www.aber.ac.uk/geiriadur*

Weather	**Amser, ardymer, ardymyr, artemper, artempr, awel, gytin, hin, hinon, tymer, tymyr, tywydd, tewy, towydd**	
	Fine weather (generally)	Arafin, ardymer, ardymyr, artemper, artempr, calm, codi aeliau (am y tywydd) [to clear up of the weather], eglurder, ffeinhau [to become fine of weather], gweddaidd, hinfalch, hinon, irlwydd, llarieiddrwydd, llathraidd, meiriolin [thawing], moeldes [hot], sychgoli [to clear up of the weather],
	Bad weather (generally)	Afrywiog, afrywog, afrywiogrwydd, agarwedd, anardymyr, annhymherus, annhymoreiddrwydd, anserchog, breithin, caled, ceulo (brew for), drycin, drycinedd, drycinllyd, drycinog, drycinol, fflatio [to become dull], gerwindeb, garwindeb, gerwineb, garwineb, gwinau [cloudy], gwlybaniaeth [rainy], gwlybyrwch [rainy], gwlyborwch [rainy], gwlypin [wet], gwresogwlyb, hirwlyb [wet], oerni [cold], tywydd cyfatal, tywydd, tewy, towydd
Wind	**Anadlwynt, anadlyn, cawod wynt, cawad wynt, cafod wynt, cwthwm, gwth (o) wynt, gwthwm, cwthwn, gwthwn, chwa (o) wynt, chwifflyn, chwythwm, fflaw, ffugl, gwth o wynt, gwynnaeth, gwynt**	
	whirlwind	Awel dro, cwthwn tro, chwyrlwynt, ffalm, ffalmwynt, gorwynt, gyrwynt, hyrddwynt, lluwch, toredwynt, trowynt
	windy	Awelog, chwaol, chwawiog, -ol, chwythlyd, ffuglog, -iog, gwyniarog, gwynnog, gwnnog, gwyniog, gwyntog, gwyntiog, gwyntol, hirwynnog [continually], sythawelog [breezy and chilly],
	Strong wind	Brythwch, drycwynt, drygwynt, gwyniar, lleibwynt, lluchwynt, lluwchwynt, morwynt
	Winter wind	Gaeafwynt
	Light wind / Breeze	Awel, awelyn, ffugl
Winter	**Gaeaf**	
	Winter solstice	Alban Arthan, byrddydd gaeaf, haul-orsaf (y) gaeaf, heulorsaf (g)aeaf, heuldro'r gaeaf
	Winter fallow	Braenar gaeaf, granar gaeaf, brynar gaeaf
	Winter storm	Gaeafrawd
	Severe winter weather	Hèth, iaeth, iaaeth

REQUEST

If you are aware of a long running documentary account(s) that you believe the authors would be interested in, please contact Cerys Jones (caj08@aber.ac.uk) or Neil Macdonald with a brief description of the source, and, if not publically accessible, please provide contact details to arrange access in the future. Accounts of particular interest are long-running diaries (greater than 10 years in length) prior to the twentieth century that recorded the weather, or lake/river levels on a regular basis.

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